USING A STUDENT- MADE MANIPULATIVE TO WORK WITH DIRECTED NUMBERS

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Running Head: Student-Made Manipulative for Directed Numbers.

Abstract

This article seeks to address a common problem that many Mathematics students have with directed numbers. Directed numbers are either positive or negative.More importantly, many students seem to think that directed numbers have no tangible significance in real life. The paper uses a student-made manipulative to encourage students to appreciate that they could be an integral part of the teaching/learning process. The manipulative comprises a self made ruler with a zero mark and positive and negative numbers on either side of the zero. A 'mover' or slider also made from Bristol Board moves smoothly along the ruler. The manipulative is used to calculate commonly met textbook problems on directed numbers. Common every day examples serve to bring to real life the value of directed numbers. Practitioners could use this article a stimulus to formulate manipulatives that they could use in their classroom practice and relate mathematics to real life situations.

Keywords: directed numbers, mathematics, ruler, manipulative, teaching/learning.

Introduction

Some grade five students often have difficulty in appreciating the value of directed numbers especially in real life situations. A directed number has both direction and magnitude or size. It's like a vector quantity that students learn about at a later stage. When one direction is used as positive the other will be regarded as negative. For instance if right is used as positive then left is treated as negative. If east is used as positive then west is regarded as negative and so forth. This article shows how students successively worked with directed numbers using their student-made manipulative.

Before I embarked on this project to use a student-made manipulative many of my students were having difficulties in understanding several basic concepts involving directed numbers. Sometimes they would obtain one answer for a given question and another answer for the identical question. This turned out to be extremely frustrating for both teacher and students alike. In an effort to stop this situation I decided to have the students construct their own manipulative and use it to work with directed numbers. In

this way the students would feel an integral part of the learning process and find fun in their work.

The Activity

I provided each student with coloured three ply Bristol Board from which they cut out a length of 1" by 24" each. Each student then folded a 1" by 3.5" piece of three ply Bristol Board using a different colour over the 1" by 24" longer piece to produce a smooth sliding motion in both left and right directions. We called this moving band our 'mover'. I checked that the dimensions were accurate and I also allowed students to check the dimensions of their peers. Together we corrected any deviations from the exact dimensions. The process was iterative until accuracy was established.

We chose the 12" mark as the zero point on the 1" by 24" piece of Bristol Board, I had students mark off equal 1" intervals on the right of the zero point and number them from +1 to +11. I also had students mark off equal 1" intervals on the left of the zero point and number them from -1 to -11. The following figure shows a part of the arrangement ranging from – 5 to + 5.

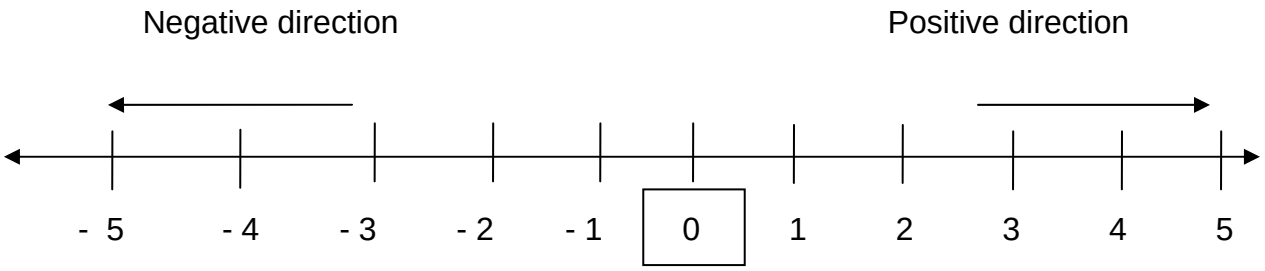

Figure 1: A portion of the designed number line in picture

As an illustration showed my students how to locate – 2 by placing the left hand side of the 'mover' directly at -2 on the 1" by 24" longer piece of Bristol Board. I moved around the class to ensure that all my students were following the directions and no one was left behind. There were some instances where I had offer assistance but by and large most students were fine on the task. I repeated the task for other numbers like + 6, - 8, + 9, -7, -10 and + 4. I ensured that all my students understood the instructions and were comfortable with the assignment. Some of the questions I asked were:

1. Where would you place your band to illustrate +6?
2. Where would you place your band to illustrate - 8?
3. Where would you place your band to illustrate +9?
4. Where would you place your band to illustrate -7?
5. Where would you place your band to illustrate - 10?
6. Where would you place your band to illustrate +4?

From this exercise we discussed the students' observations and noted the following:

1. Heading in a **POSITIVE** direction means heading in the **RIGHT** direction.
2. Heading in a **NEGATIVE** direction means heading in the **LEFT** direction.

We also tried to find parallels in real-life situations like doing the right thing makes you head in the right direction while doing the wrong thing makes you head in the left direction. Other real-life analogies included making right decisions produced positive effects compared to making not making right decisions that produced negative results. A number of students shared their personal experiences. There were several humorous stories that provoked a lot of laughter and lightened the class atmosphere. The important point was that the students had internalized the concept of positive and negative indicative of right and left directions.

We commenced the session with simple examples like:

2 + 3

I explained to my students that in order to solve 2 + 3 we could think of beginning at 2 and adding or moving 3 places to the **RIGHT** of + 2. I then placed the 'mover' at + 2 and slowly moved 3 places to the **RIGHT** of +2. This brought me to + 5 as shown in the figure that follows.

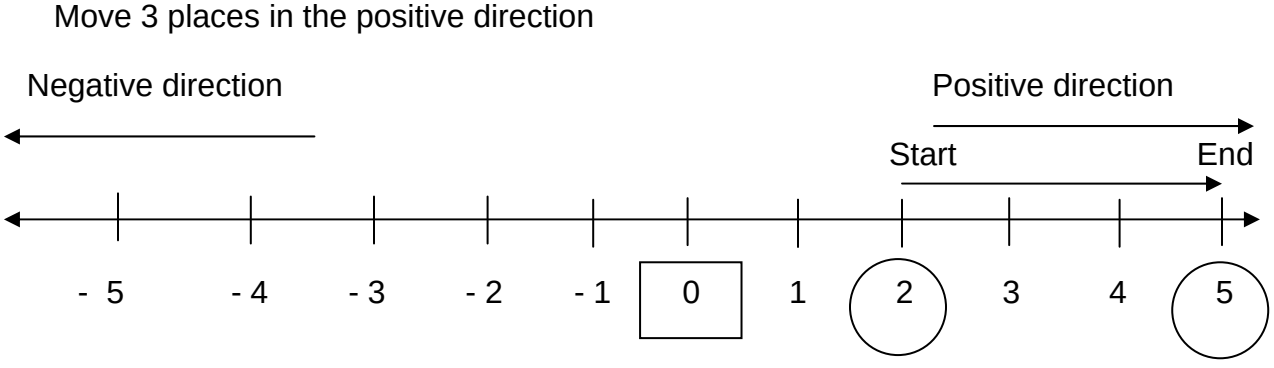

Figure 2: Number line in picture

2 + 3 = + 5

The next step was to solve simple problems like:

- 2 + - 3

I explained to my students that in order to solve - 2 + - 3 we could think of beginning at – 2 and adding or moving 3 places to the **LEFT** of -2. I then placed the 'mover' at – 2 and slowly moved 3 places to the **LEFT** of -2. This brought me to – 5 as shown in the figure that follows.

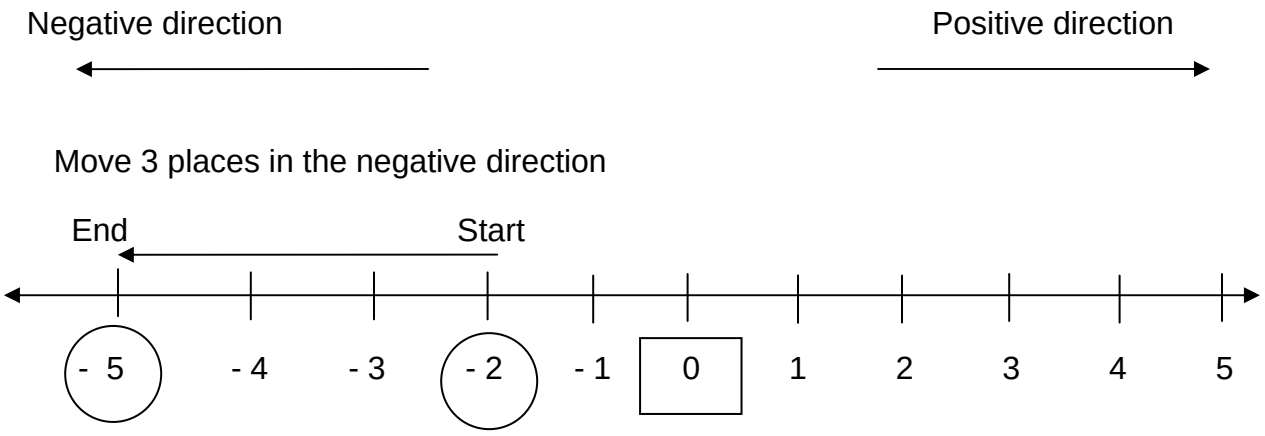

Figure 3: Number line in picture

- 2 + - 3 = -5

I always try to make Mathematics as authentic as possible so my students could connect with real life situations with which they are familiar. Hence, as a practical illustration I suggested that students think of Jo (one of the class members) borrowing two books from Jim (another classmate). Subsequently Jo borrows another three books

from Jim. I then ask students how many books in total did Jo borrow from Jim. Very quickly they replied a total of five books. Since this indicates a debt it may be represented by – 5.

Another familiar example involved Sue owing Yan two dollars on Monday and another three dollars on Tuesday. Together the students agreed that Sue owed Yan five dollars. Once again because it is a debt it may be represented by – 5. At this stage I allowed my students to suggest examples that illustrated '- 2 + - 3 = -5'. My students were overjoyed to offer numerous examples and tell their individual stories. This turned out to be a fun activity that they enjoyed a lot.

I followed this up with several similar lessons that illustrated addition with both positive and negative numbers like:

- 2 + 3

I explained to my students that in order to solve - 2 + 3 we could think of beginning at – 2 and adding or moving 3 places to the **RIGHT** of -2. I then placed the 'mover' at – 2 and slowly moved 3 places to the **RIGHT** of -2. This brought me to +1 as shown in the figure that follows.

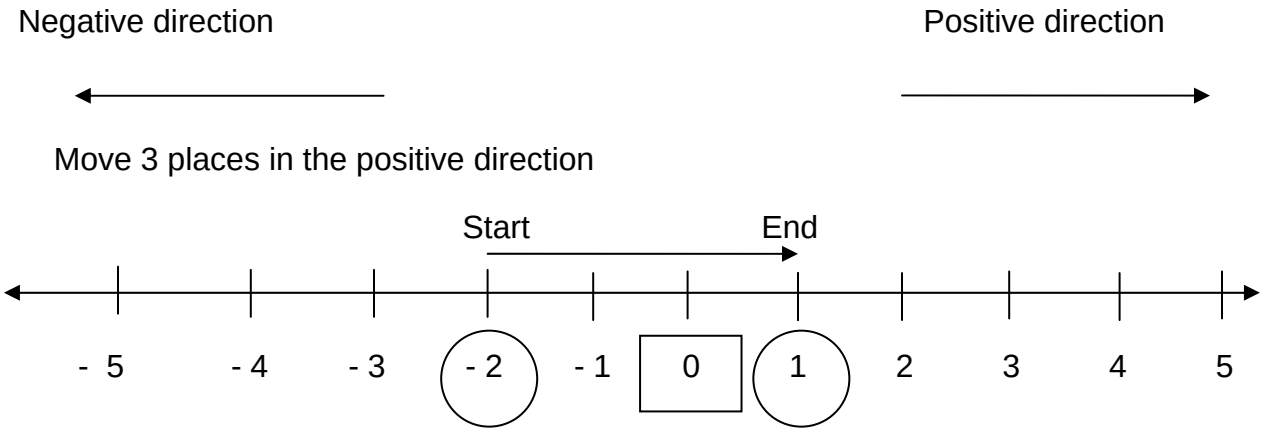

Figure 4: Number line in picture

- 2 + 3 = +1

Conclusion

Thereafter my students could be given a number of examples and obtain correct answers. Additionally, they were able to provide relevant real life examples to illustrate what they were doing in the classroom.

We trust that that selected examples would help teachers to clarify difficult-to-understand concepts that arise in their classroom and at the same time allow their students to have fun in learning and see useful connections with their everyday situations.

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